COMPARATIVE STUDY OF PUMP THERAPY AND NODOVENOUS SHUNT ON EARLY FILARIAL LYMPHEDEMA

Dissertation submitted for

M.Ch DEGREE EXAMINATION

(PLASTIC AND RECONSTRUCIVE SURGERY)

Department of Plastic and Reconstructive Surgery,

Govt. Thanjavur Medical College and Hospital,

Thanjavur.

Tamilnadu, INDIA.

TAMILNADU DR M.G.R. MEDICAL UNIVERSITY,

CHENNAI, INDIA.

AUGUST 2009.

CERTIFICATE

This is to certify that the dissertation entitled **COMPARATIVE STUDY OF PUMP THERAPY AND NODOVENOUS SHUNT ON EARLY FILARIAL LYMPHEDEMA** is a bonafide record of work done by **Dr.R.SANTHARAM,** in the Department of Plastic Surgery, Thanjavur Medical College, Thanjavur, during his course period from 2006-2009 under the guidance and supervision of **Prof. Dr.V.DEVASENAN,M.S.,M.Ch.** This is submitted in partial fulfillment for the award of **M.Ch. BRANCH III PLASTIC SURGERY DEGREE EXAMINATION** to be held in August 2009 under the Tamilnadu Dr. M.G.R Medical University, Chennai.

The Dean,
Thanjavur Medical College,
Thanjavur.

Professor and Head,
Department of Plastic Surgery,
Thanjavur Medical College,
Thanjavur.

DECLARATION

I hereby declare that this dissertation entitled **COMPARATIVE STUDY OF PUMP THERAPY AND NODOVENOUS SHUNT ON EARLY FILARIAL LYMPHEDEMA** has been prepared by me from the Department of Plastic Surgery, Thanjavur Medical College Hospital, Thanjavur, during my course period 2006-2009 under the guidance and supervision of Prof.Dr.V.DEVASENAN,M.S.,M.Ch.

This is submitted to **THE TAMILNADU DR.M.G.R. MEDICAL UNIVERSITY** in partial fulfillment of the requirement for the award of **M.Ch. PLASTIC SURGERY DEGREE EXAMINATION** to be held in August 2009. This record of work has not been submitted previously by me for the award of any degree or diploma from any other university.

Dr.R.SANTHARAM.

CONTENTS

ACKNOWLEDGEMENT

I take this opportunity to place on record my gratitude and thankfulness to all my teachers.

I thank **The Dean,** Thanjavur Medical College for granting me permission to conduct this study.

I am indebted to **Prof.Dr.V.Devasenan, M.S.,M.Ch.,** Professor and Head of the Department of Plastic Reconstructive and Filarial Surgery, Thanjavur Medical College who has been my Guide during this study, for his constant guidance and advice.

I owe my sincere heartfelt thanks to our mentor **Prof.Dr.Joseph Victor, M.S.,D.N.B.,M.Ch., Prof.Dr.R.Sridharan, DLO.,M.S.,M.Ch., Prof.G.Ambujam, M.S.,FICS.,** for their encouragement and advice.

I sincerely thank my Assistant Professors **Dr.P.Ravindran, M.S.,M.Ch.,FICS, Dr.D.Rajkumar, D.Ortho, M.S.,M.Ch., Dr.U.Prabhakaran, M.S.,M.Ch.,** for their support and suggestions.

My thanks are due to **Dr.K.Mohamed Ali, M.D.,** for helping me with the statistical analysis of the study.

It is an immense pleasure to thank my fellow Post-graduates-Seniors and Juniors for their help and support.

I thank our Ward Staffs for their kind cooperation during the study.

Last but not the least, my thanks and gratitude are to the patients for their cooperation without whom this study would not have been possible.

INTRODUCTION

The WHO in 1984 considered that 3% of total population was infested with Filaria i.e. (90 million people) with atleast 45 million clinically affected by it. (1)

The disease as it progresses tends to undermine the ability of an individual to work, to contribute their family, in addition to his/her suffering which are both physical and psychological. Pain due to recurrent infection, impaired mobility, poor hygiene, loss of self esteem, depression and adjustment disorders to name a few. (2)

Though, prevention is ideal, considering the magnitude of the problem, any effort or management strategy that would decrease the morbidity by retarding or arresting the progression of disease will be of immense value to the patients by helping him / her to be less dependent and more productive to the community itself.

OBJECTIVE OF THE STUDY

To analyse and compare the outcome of Pump therapy and Nodovenous Shunt on Early Filarial Lymphedema.

REVIEW OF LITERATURE

BASIC SCIENCE:

ANATOMY:-

The lymphatic system consists of

- Lymph capillaries where lymph is formed and collected
- Lymph vessels which carry the lymph to the regional lymph nodes
- The larger collecting channels, emptying the lymph into the venous system in the neck via the thoracic duct and the right lymphatic trunk. (3)

Micro anatomy:

Salient Features:-

Lymph capillaries consists of single layer of epithelial cells. They do not have any basement membrane and are surrounded by the loosely adherent collagen tissue.

The functional unit is lymphangion which is segmentally contractile.

The intercellular junction of the capillary wall has minute clefts with overlapping of the cells to act as flap valves. A small proportion of these can open widely to accommodate fluid as required, being held apart by collagen microfibrils which open up very widely.

Essentially the structure is the same as blood capillaries but here the holes are more profuse – from 1% to 6% of the capillary surface area.

The lymph capillaries can distend two to three times of their size and also constrict to make their lumen invisible.

The lymph vessels have unidirectional valves which allow lymph to flow in a centripetal direction.

These valves are located about a centimeter apart to make the lymph vessels appear like a string of pearls.

The lymphatics of the skin are distributed with a proportion equalling that of the blood capillary system. (4)

It is delineated as superficial and deep systems that ramify throughout the body contiguous with the venous system but separate from it. (5)

In the subcutaneous tissue, the valved collecting channels run obliquely or vertically within connective tissue strands linked by horizontal arcades.

These empty into the main lymphatic trunk close to the deep fascia.

Muscles in the body have no lymphatic supply, but the lymph trunks have been found next to the perimysium internum i.e., around the blood vessels.

PATHOPHYSIOLOGY:

Lymphedema describes a clinical condition in which there is accumulation of interstitial fluid.

This pathologic accumulation may be due to congenital mal development of lymphatic system (primary) or an acquired condition (secondary).

In lymphedema the delineation between superficial and deep system becomes indistinct with onset of lymphatic obstruction resulting in communication in superficial and deep systems and between lymph and venous channels. (6)

The main function of lymphatic system is to clear proteins and lipids from interstitial space to the vasculature by use of differential pressure.

The intra lymphatic pressure is low. Muscle contraction and differential of abdominal and intrathoracic pressure occurring with respiratory effort propel lymph. Fat and protein diffuse into the numerous intercellular gaps into lymphatic capillaries. Thus it is able to clear nearly half of the circulating albumin from interstitium every day. (7)

When there is a disruption to the flow due to whatever the cause may be – i.e., primary or secondary – lymphatic load exceeds capacity. Intralymphatic pressure builds which leads to flow stagnation and valvular incompetence. These factors in combination leads to dermal back flow resulting in accumulation of protein rich fluid in extra cellular space. (8)

This fluid which is rich in macro molecular protein and hyaluronan accounting for increased colloid osmotic pressure resulting in influx of water and increased interstitial hydraulic pressure. (9)

Also there is increase of fibroblasts, monocytes, adipocytes and keratinocytes in tissues leading to fibrovascular proliferation which contribute to the brawny non-pitting edema. (9,10)

Degeneration and thickening of elastic fibers of basement membrane of lymphatic channels leading to obliteration of the channels due to proliferation of ground substance, inflammatory cells and fibroblasts. (11,12)

CLASSIFICATION:

It is based upon distinction between primary and secondary causes of the disease.

Primary lymphatic obstruction may be due to,

Lymphatic hypoplasia

Functional insufficiency or

Absence of lymphatic valves (3)

Based on the time of manifestation, it has been classified as,

Lymphedema Congenita – within first two years of life
(Milroy's disease)

Lymphedema precox (early lymphedema or Meige disease
diagnosed during puberty can appear
as late as the third decade)

Lymphedema tarda – presents after 35 years of age

Another classification based on the morphologic characteristic of lymphatics as seen in lymphangiography.

Aplastic lymphedema – shows normal dermal plexus with total absence of subcutaneous lymphatics.

Hypoplastic lymphedema:

Obstructive

Non-obstructive

- Distal hypoplasia of lymphatics with bilateral peripheral edema of lower extremities.

Obstructive: - decrease in number of proximal lymphatics

Non-obstructive:- adequate number but inadequate caliber of vessels.

Lymphatic hyperplasia with mega lymphatics. – shows an increase in both size and number. Presents with unilateral edema of entire lower extremities. (13)

Secondary lymphatic edema

The causes include surgical, traumatic, infections, inflammatory or neoplastic that results in compromise of lymphatic pathways.

Among the secondary causes, Filariasis is the leading one affecting more than 90 million people. In the western hemisphere, secondary lymphedema is a sequale to surgery or radio therapy. (14)

DIAGNOSIS:

Diagnosis of lymphedema is by and large clinical based on the history and physical findings. For the same reason, it is observer dependant.

History:

Symptoms such as swelling, its duration, any painful episodes, regional adenitis or ascertained. As far as the signs, the classical ones are peau de orange, Stemmer Sign – inability to tent the skin over the toes – and the blunted appearance of the digits of the involved extremities. (15)

As far the objective assessment goes circumferential limb measurement has been most commonly used with a difference of 2 cms from the opposite limb considered significant. Other tests used are Volume displacement and Serial Photography. (16)

DIFFERENTIAL DIAGNOSIS:

Edema due to pregnancy

Chronic Venous Insufficiency

Myxedema in hypothyroidism

Thyrotoxicosis,

Lipedema – abnormal accumulation of subcutaneous fat between pelvis and ankle. Mostly affecting hips and thighs, usually sparing the feet.

DIAGNOSTIC STUDIES:

Contrast Lymphangiography

Indirect Lymphangiography

Isotopic Lymphoscintigraphy - Widely practiced. Used as a corner stone in the diagnosis, classification and evaluation of lymphedema. Tc 99m labeled antimony sulfide colloid, Rhenium sulphate or Human serum albumin nano colloid is injected into the dermis in the inter digital space of the affected limb. A gamma camera is used to follow transport of Macro molecule providing both static anatomic information and dynamic assessment of lymph flow. Former being useful for evaluation of moderate to severe lymphedema and the latter useful for mild forms of lymphedema. (16)

Other Modalities:-

MRI

CT – SCAN

ULTRASONOGRAPHY

In MRI / CT-SCAN, Chronic lymphedema of epifascial compartment exhibits a characteristic honey comb appearance differentiating it from venous edema which affects both epifascial and subfascial compartments.

Ultra-Sonography is a valuable non invasive method to quantify the volume of edematous lower extremities. (16)

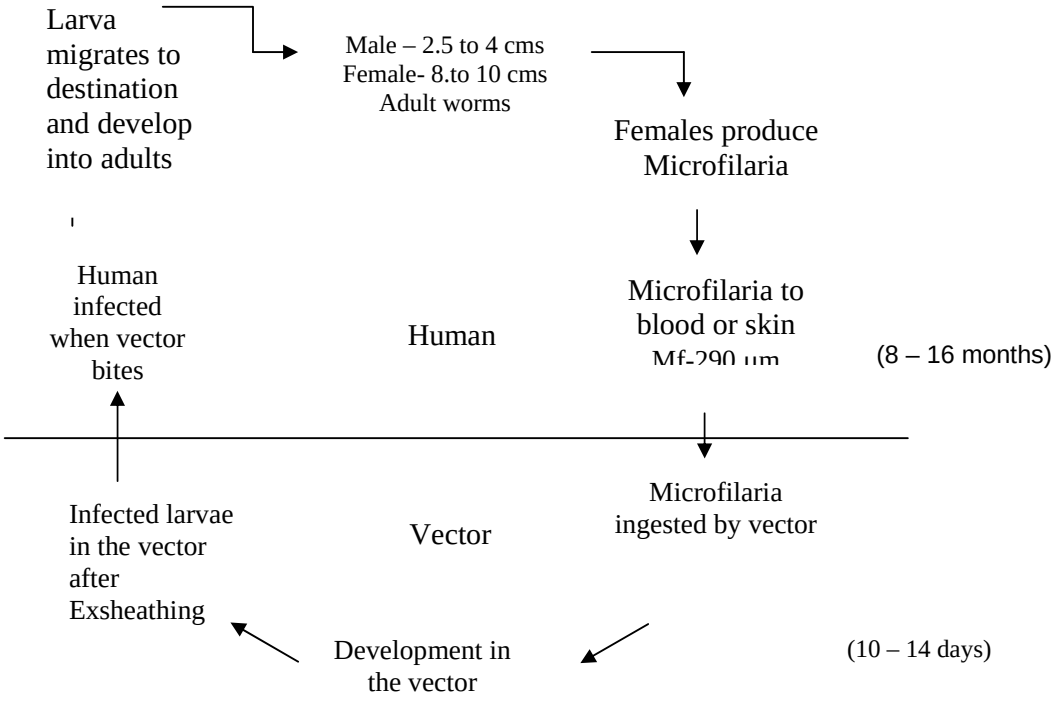
LYMPHATIC FILARIASIS – AN OVERVIEW

It covers infection with three closely related nematode worms. *Wuchereria bancrofti, Brugia malayi* and *Brugia timori*.

All three are transmitted to man by bites of infectious mosquitoes. (Viz. Culex, Mansonia, Anopheles species)

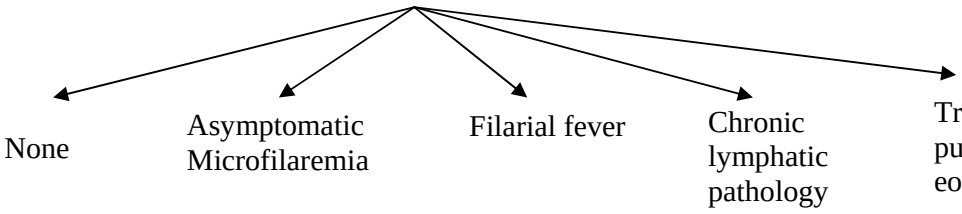
All three parasites have similar life cycle with man being the definitive host and the vector – mosquito – the intermediate host. (17)

Life Cycle:



Clinical Manifestation:

It varies over a spectrum.



- Lymphedema of limbs
- Chyluria
- Hydrocoele
- Elephantiasis

(18)

When it manifests, it can be acute or chronic.

Acute - Fever, lymphangitis, lymphadenitis, reversible lymphedema of various parts of the body, epididymoorchitis in male.

Chronic - This is due to fibrosis and obstruction of lymphatic vessels leading to permanent structural changes seen as, Lymphedema of different grades Chyluria, Hydrocele and Elephantiasis in its worst form.

Lymphedema in filariasis:

The adult worms localise in the lymphatics and cause blockage of the lymphatic trunks to result in lymphedema. Repeated lymphangitis related to release of microfilaria is however common. Macrophage action as well as the release of complement and other inflammatory proteins results in blockage of a wider group of lymphatics. (19)

In endemic areas, massive infections as well as reinfection by streptococcal infection are responsible for the lymphedema.

Lymphangitis is due to,

- Mechanical irritation
- Liberation of toxic fluid by the female worm during parturition.
- Paralysis of Lymphatic peristalisis by the toxins
- Absorption of toxic product or allergen by the disintegration of the adult worm.
- Secondary streptococcal infection

The essential feature being the blockage of lymphatics over a distance of few centimeters at a certain level or even all through the limb.

Elephantiasis – the extreme end of the spectrum with dermatosclerosis and pappillomatous changes in the skin is due to,

- Repeated infection of multiple lymph channels
- Endo lymphangitis of the proximal portion obstructing lymph flow.

- Dilatation of the distal part of the lymphatics and lymph stasis leading to fibrotic changes.

- Infection

- Inability to establish adequate collaterals through hypertrophied tissues.

Diagnosis:-

Usually the diagnosis is made from the following

- History

- Clinical features

- Lymphangiogrphy

- Lymphoscintigraphy

- CT Scan

- Study of lymph fluid

- Night blood smear for microfilariae by Millipore technique

- Tests to rule out TB, LGV

- Cytoimmunochemistry – Detection of filarial antigen and antibody Serum immunoglobulins

- Urine examination and microscopy

- Radio-iodine human serum albumin (rihsa) uptake studies. (20)

History:

Recurrent attacks of fever with chills accompanied by adenitis.

Swollen limbs – reversible or irreversible,

Genital swelling

Place of dwelling (if within endemic area)

Clinical Features:-

As the patients present mostly if not invariably with edematous limbs, this becomes the single most important finding in filariasis.

In view of assessing the severity of the disease, a grading system is employed to grade the edematous limbs.

Grading:-

Grade I - Mostly pitting edema. Clinically no or some fibrosis. Spontaneously reversible on elevation of limb.

Grade II - Mostly Non-pitting edema. Moderate to severe fibrosis. Not spontaneously reversible on elevation of the limb.

Grade III - Increase in circumference of limb more than 5 cm at one or more levels when compared to normal limb irrespective of increase in size.

Grade IV - Limbs with pappillomatous and a warty projection in the edematous limbs irrespective of size of the limb. (21)

Specific test for detection of Microfilariae:

Detection of microfilariae in blood:

Capillary finger-prick or venous blood is used for thick blood films. Venous blood also can be concentrated or passed through a Nucleopore filter before being examined microscopically. The species of infection then can be determined by the microscopic appearance.

Microfilaria may be periodic in appearance in the peripheral circulation, and the blood should be examined at different intervals over a 24-hour period to achieve the best chances of detection.

Provocation of nocturnally periodic microfilariae may be achieved with a daytime dose of DEC at 1-2 mg/kg.

Microfilariae also may be observed in chylous urine and hydrocele fluid.

Microfilariae may be absent in patients with Adeno Lymphangitis or late chronic lymphatic disease.

Detection of filarial antigen:-

The presence of circulating filarial antigen in the peripheral blood, with or without microfilariae, now is considered diagnostic of filarial infection and is used to monitor the effectiveness of therapy. Commercial kits are available to test venous blood.

Complete blood cell count:

Eosinophilia is marked in all forms of patients with filarial infection.

Serum immunoglobulins:

Elevated serum lgE and lgG4 may be observed in patients with active filarial disease.

Histologic Findings:

Affected lymph nodes fibrose.

Lymphatics stenose and get obstructed with the creation of collateral channels.

The skin of individuals with elephantiasis is affected with hyperkeratosis, acanthosis, lymph and fatty tissue, loss of elastin fibers, and fibrosis.

Lymphangiography:-

A radio-opaque dye lotrolan has been used to delineate lymphatics radiologically after subcutaneous injection.

Present day techniques use ultra-fluid Lipiodol, a fatty based substance as contrast injected via a special slow injector pump. (18)

In secondary lymphoedema, the changes are of dilatation leading on to dermal back flow, varicosity, tortuosity and obliquity.

The initial changes in lymphangiography are of secondary lymphoedema but at a later stage, they may get fibrosed and decrease in number.

Grades I and II shows extensive proliferation, varicosities and collaterals which decrease with severity.

In later grades, the lymph vessels decrease in number but still exhibit dermal back flow.

Thus an elephantiatic limb (gr. IV) shows very few lymph channels.

THE INDIAN SCENARIO:

The Problem:-

- 429 million people exposed to risk of infection
- 31.3 million are microfilaria carriers
- 7.8 million lymphoedema / elephantiasis cases
- 12.9 million hydrocele cases

- India alone accounts for 42.8% of global problem due to *W.bancrofti* and 20.2% due to *B.malayi*.

The distribution

- The traditional endemic foci are situated around river basins and eastern and western coastal areas.

- Of the 25 States / Union territories surveyed in India, 22 are endemic.

- Nine States (Andhra Pradesh, Bihar, Gujarat, Kerala, Maharashtra, Orissa, Tamil Nadu, Uttar Pradesh and West Bengal) contribute around 95% of overall burden.

The burden:

- Annual economic loss to India due to filariasis is to the tune of US $ 1.5 billions.
- Loss of income to individuals and families.
- Loss of productivity
- Functional impairment and restricted mobility
- social stigma and isolation, psychological stress and family discord
- Poor marriage prospects and employment opportunities
- Occupational displacement
- sexual disability
- Poor quality of life (22)

National Filaria Control Programme: (NFCP)

NFCP has been in operation since 1955.

NFCP is being implemented through 206 filaria control units. 199 filaria clinics and 27 survey units primarily in endemic urban towns.

Revised Filaria Control Strategy:

WHO recommendation of single dose mass drug administration with DEC / DEC + Albendazole.

Goal is to eliminate lymphatic filariasis by 2015.

Broadly, control programme includes Vector control through anti larval operations, source reduction, detection and treatment of microfilaria carriers and morbidity management. (17,22)

MANAGEMENT OF LYMPHEDEMA

Medical Management:

Limb elevation with massage and exercises.

Compression therapy – Uniform pneumatic compression

Sequential compression by hydrostatic pressure

Sequential pneumatic compression

Complex physical therapy

Pharmacotherapy

Surgical Management:

Physiologic techniques

Lymphangioplasty

Bridging techniques

Lymphatic anastamoses

- Lymphatic – Lymphatic
- Lymphatic venous
- Lymphatic Venous Lymphatic
- Lymph node Venous anastomosis
- Microlymphatic – Venous anastomosis (MLVA)

Excisional Techniques:

- Charles'
- Kondoleon
- Sistrunk
- Homans'

Suction Assisted Lipectomy

Medical Management:-

The basic principle involved is avoidance of secondary infection and application of compression to maintain or improve limb volume.

A number of modalities and protocols have been devised and practiced.

- Limb elevation along with massage and exercises with or without compression garments.

- Compression therapy which can be uniform pneumatic compression or sequential compression by the hydrostatic pressure.

- Complex physical therapy also known as Complex Decongestive Therapy (CDT).

This is carried out in stages and in two phases.

Ist Phase: As an in-patient

IInd Phase: Self management

The steps include:

Hygienic measures to avoid fungal and streptococcal infection in particular.

Manual Lymph Drainage (MLD)

Here, special massage technique is commenced on contralateral quadrant of the trunk which is free of lymphostasis to increase

lymphokinetic activity in normal tissues. Ultimately, facilitating drainage across lymphatic water shed. (23)

Manual lymphatic mapping – is to locate the direction or route of drainage of lymph for specific areas.

Concomitant application of elastic bandage which, not only counter balances the elastic insufficiency but also increase tissue pressure.

Remedial exercises performed with bandages worn which exert lymphokinetic effect.

At conclusion, i.e. 4 weeks, elastic stocking support is prescribed with the main objective of prevention of re-accumulation of fluid. (24-27)

Pump Therapy:-

The use of pumps has been in vogue in the past 50 years. The methods employed have been either uniform or sequential compression. A proposed theory for the action of pumps is based on the fact that, pressure generates heat. And based on the universal gas equation PV/T = Constant. i.e. at Constant Volume (V) rise in pressure (P) results in rise in temperature (T) which is known to bring about reduction. A word of

caution has also been sounded that compression should not be in rapid increments of pressure but in smaller increments for longer duration, especially while using sequential pump therapy. (28,29)

Some of the studies show convincing results in non-malignant early lymphedema for Pump therapy. One criticism against Pump therapy has been the cost factor. To circumvent this, efforts have been made to design cost effective indigenous pumps that can work effectively and easily, thus making it available for more number of patients.

Heat and Bandage Therapy:-

An electro controlled heating chamber with the temperature to 120^{o} C elevates the temperature of extremity by $6^{o} – 7^{o}$ C. Upto 1 hour once a day for 20 days. 3 to 5 cycles are given. (27)

Pharmaco Therapy:

Drugs that have been employed are benzopyrene (Coumarin), flavinoids, antibiotics. DEC (Diethyl Carbamazine) forms an integral part of the treatment of filarial lymphedema. (27)

DEC is known to alter the membrane of microfilaria so that they are readily phagocytosed by tissue fixed monocytes but not circulating phagocytes. Prolonged treatment may be wormicidal.

Other drugs used are albendazole and ivermectin.

Surgical Techniques:

Physiological techniques which favor or enhance lymph drainage.

Lymphangioplasty:

Placement of silk sutures into subcutaneous tissues of lymphedematous extremities would act by capillary force to promote lymphatic flow.

Bridging Techniques:

Disruption of underlying fascial barrier to establish communication between deep and superficial systems of lymph drainage. Kondoleon was the proponent.

As an extension of this method, interposition of normal tissue into lymphedematous area to enhance drainage of the obstructed systems.

Thompson used a buried dermal flap.

Enteromesentric bridge co-apted to inguinal lymph node to bye-pass obstructed pelvic nodes.

Omental transfer, musculocutaneous and fasciocutaneous flaps attached to lymphedematous sites have been tried. (30)

Lymphatic anastamoses:-

Different Anastamoses are described and practiced in an attempt to relieve obstructed lymphedema.

Lymphatic – Lymphatic

Lymphatic venous

Lymphatic Venous Lymphatic

Lymph node – Venous (Nodovenous Shunt – Nieulubowicz, Olszweski). (31)

Co-apting of a sectioned lymph node to an adjacent vein based on the fact that high pressure lymphatics would drive drainage of lymphs into venous system. This was popularized and put into practice in our country by Prof.S.Jamal.

Microlymphatic venous end to end anastomosis by O' Brien (MLVA) between lymphatic vessels and veins has shown good results.(32)

Interposition of vein grafts between lymphatic channels both proximal and distal to the site of obstruction. (33)

These techniques have been used in isolation or in combination with excisional techniques.

Excisional Techniques:

Charles' procedure – Involves radical excision of all involved lymphedematous tissue including skin, subcutaneous tissue and fascia. The resultant wound covered with split or full thickness skin grafts.

Kondoleon suggested staged excision of subcutaneous tissue. This was later modified/refined by Sistrunk and popularized by Miller and Homans'. This procedure has been the main stay of excisional techniques.

All these patients require elastic support in the form of stockings to maintain the post operative results. (34-37)

Suction Assisted Lipectomy:-

This is usually combined with another procedure such as lymphovenous anastamosis or surgical excision. (38)

MATERIALS AND METHODS

Background of the Study:

The study was carried out at the Department of Plastic Reconstructive Surgery, Thanjavur Medical College Hospital (**TMCH**)

Since Thanjavur and the surrounding areas are endemic zone for Filariasis, the Department runs a special clinic for filarial patients.

CENSUS

	2004	**2005**	**2006**	**2007**
Beds Allotted	10	10	10	10
Total OP Attendance	5458	4863	669	5931
New Cases	513	460	196	259
Old Cases	4945	256	473	5672
Admissions	93	57	68	59
Operations	74	88	66	55
Major	65	79	52	45
Minor	9	9	14	10

Existing Protocol in treating Filarial Lymphedema patients.

Patients are seen in the filarial Out-patient Clinics on Mondays. New cases are entered serially in a separate Registry. They are started on Penidure prophylaxis.

Apart from routine screening, Grading of the limbs is done as per recommendations.

Irrespective of the Grade, they are advised regarding hygiene, avoidance of infection, to practice Limb elevation as much as possible. After 2-3 doses of Penicillin prophylaxis-injection Benzathine penicillin – 12 lacs units IM after test dose + DEC – 100 mg BD for 3 days – (When patients are found allergic to Penicillin, they are treated with Doxycycline 100mg BD for 3 days) Grade I & II patients are subjected to Nodo-venous shunt.

Grade III & IV – Nodo-venous shunt followed by reduction surgery in 1 week to 10 days time. Post-operatively, all of them are advised to wear compression stockings / elastocrepe bandage and advised to report for continuing Penidure prophylaxis, during which they are

evaluated for any recurrent infection, increase in edema and other complications.

Recording of limb measurements is usually carried out by taking circumferential measurements at standard sites of both foot and leg. Sometimes, volumetric measurement is carried out using a specially designed chamber for displacing water.

Duration of the study:

Over a period of 2 years – February 2007 to February 2009

Selection of patients:-

Patients were selected as they approached the Filarial Out-patient clinic for Penidure (Benzathine penicillin) prophylaxis. A broad outline of the treatment, whether be it, Pump therapy or Nodovenous shunt therapy, was explained to them and were included in the study after obtaining an informed consent. After this they were admitted as 'In-patients'.

GRADE I LYMPHEDEMA

GRADE II LYMPHEDEMA

MEASUREMENTS

FOOT LEVEL: 12 CMS

LEG LEVEL: 10, 20, 30 CMS

Inclusion criteria:-

- Patients from both sexes were involved
- All were adult patients
- Patients belonging to Grade I and II of Filarial Lymphedema classification alone were included.
- Allotment to a specific modality Nodovenous shunt / Pump therapy was done on alternate basis.
- Patients with known co-morbid factors such as Diabetes Mellitus, Hypertension, Ischemic heart disease, Immuno suppressive disorders were excluded from the study.

Evaluation:

On admission, circumferential measurement at standard sites both in the foot and leg were recorded and entered as 'Day 1' values.

Foot - 12 cm from tip of the great toe.

Leg – At 10, 20, 30 cms from medial malleolus.

Treatment Protocol:

Patients belonging to both groups were received in a Filarial cot with a standard elevation of 6" at the Foot end.

Nodo-Venous Shunt Group:

Taken up for surgery in 2-3 days.

Procedure:-

Carried out under local anesthesia.

Linear incision in the groin along the line of femoral vein deepened upto subcutaneous level. Long saphenous Vein identified along with adjacent lymph node.

LSVn cut bearing a proximal stump of adequate length for the Nodovenous shunt. This cut end was anastamosed with the Lymphnode. Wound closed in layers.

Received back in the ward in the filarial cot. Advised to carry on active flexion extension exercises of the ankle.

Suture removal between 10-12 days.

FILARIAL COT

VOLUMETRIC
MEASUREMENT CHAMBER

SEQUENTIAL PUMP WITH VARYIING SIZES OF ENCASEMENTS (SLEEVE)

Pump Therapy:

Right from Day1, sequential Pneumatic Pump therapy was administered for not less than 90 minutes (90-100 mins.) on a daily basis through out their stay in the hospital (2 weeks).

Procedure:

With the patient lying supine, the custom made sleeve (encasement) of the Pump was worn around the edematous limb. Once the sleeve was in place, the Pump was started which provided a sequential compression of various segments of the lower limb. A pressure varying between 50-100 mm of Hg was generated during each compression.

This procedure was repeated daily. Patient was advised to lie in the filarial cot with the foot end elevated and practice active exercises.

Both these groups of patients were discharged at the end of 2 weeks.

Subsequent to discharge from the hospital, patients belonging to both groups were advised,

- to wear elastic stockings for compression which extended from the distal end of the foot to above-knee level
- to keep limb elevated as much as possible
- to report for Penidure prophyloxis once in 15 days. During which they received an I.M injection of Benzathine Penicillin 12 lacs units after test dose and Diethyl Carbamazine (DEC) tablets for 3 days (150mgm twice daily basis).

Record of measurements:-

It was carried out on Days-7, 30 and 180 at the standard sites as on Day1.

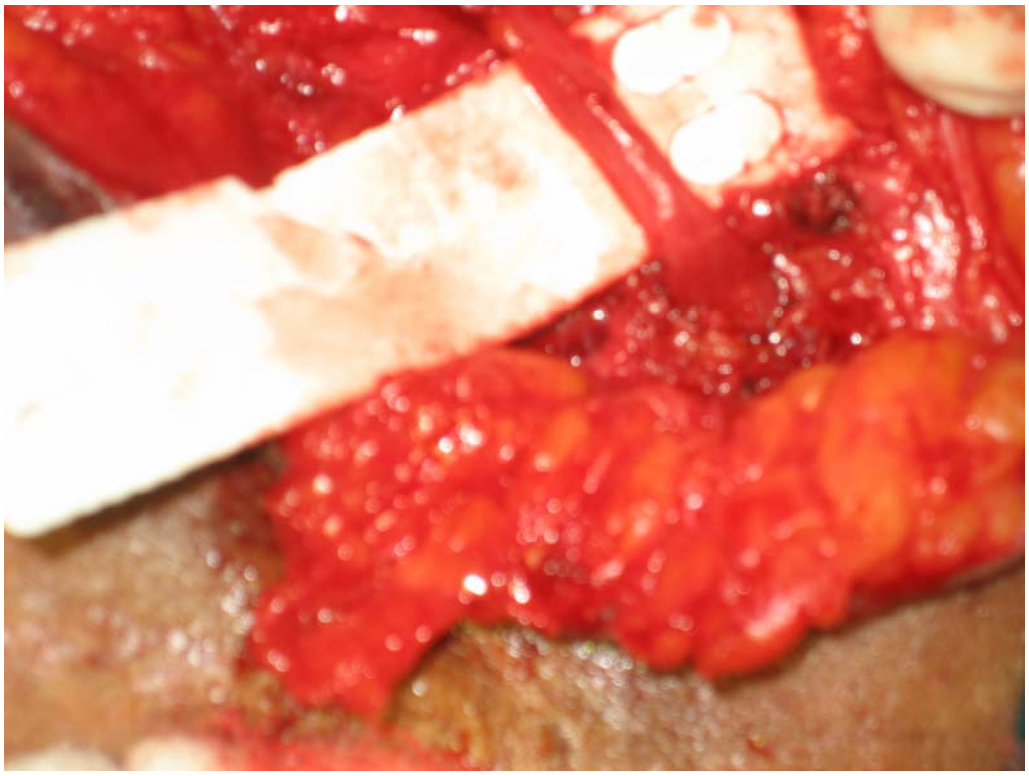
The difference was interpreted as reduction or gain in edema and was expressed in percentage (by taking the initial recording as 100%).

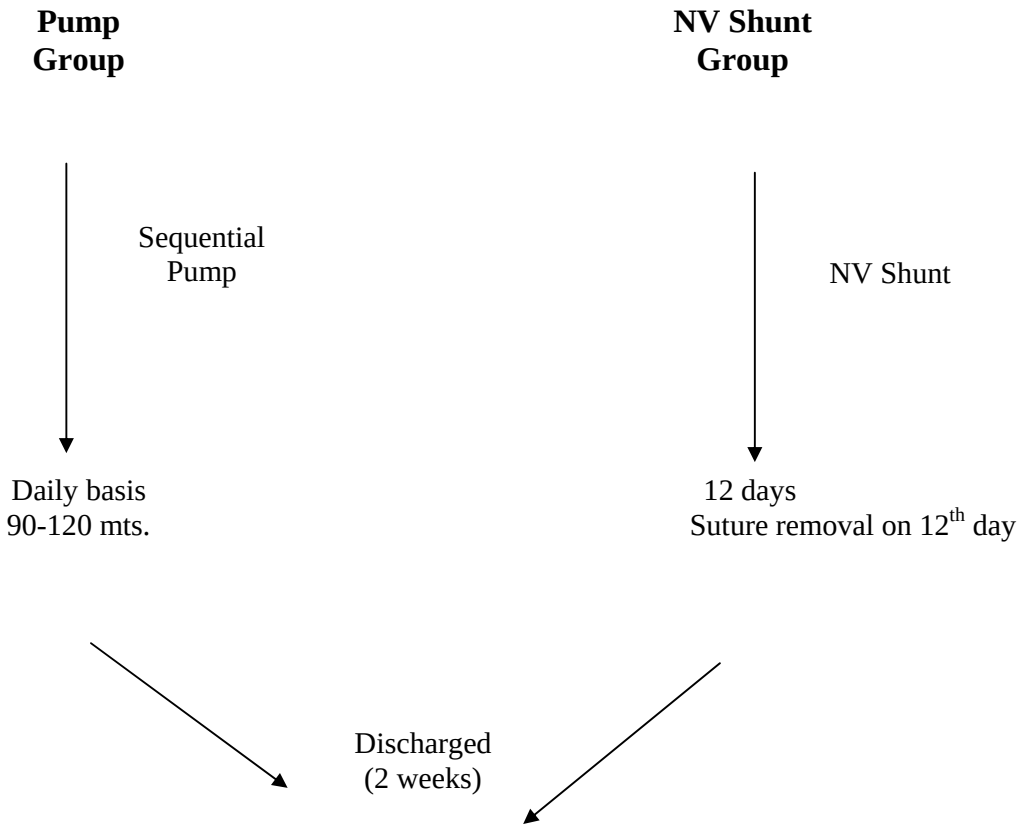
Follow-up:

Patients were followed-up as they reported for the Penidure prophylaxis once in 15 days.

PUMP THERAPY IN PROGRESS

NODOVENOUS SHUNT





- Elastic Compression
- Limb elevation
- Regular Penidure prophyloxis[[

(Periodic evaluation using measurements on days 7, 30 and 180)

Statistical Analysis :-

It was done using Paired-Samples t test which compares the means of two variables that represent the same group at different times.

The mean values for the two variables are calculated.

A low significance value for the t test (typically less than 0.05) indicates there is significant difference between the two variables.

In the current study, mean difference values were obtained for both leg and foot. In the leg 20 cms level was taken as a representative site.

Compliance:

Compliance was recorded by awarding points.

Regular visits for Penidure prophylaxis-1

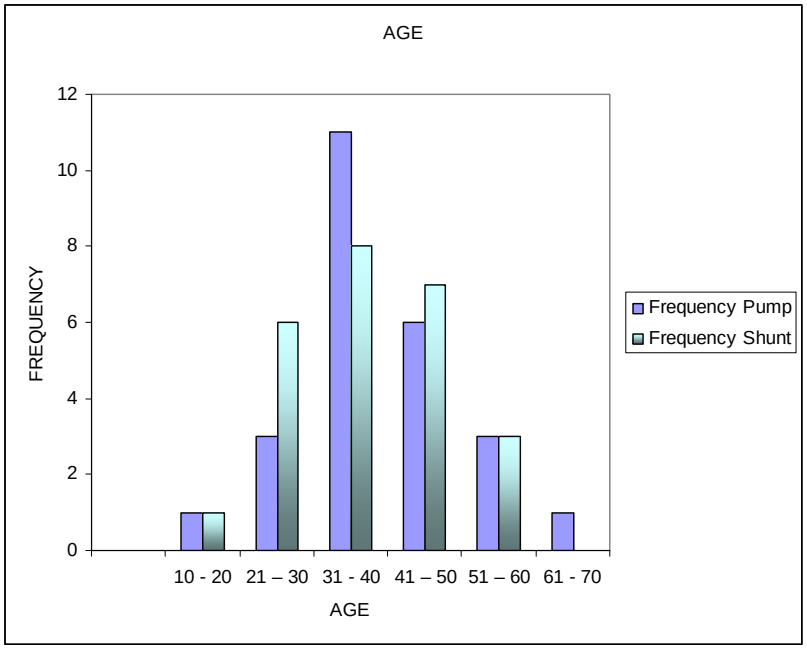
Limb elevation – 2

Wearing of Elastic Compression – 3

RESULTS

AGE:

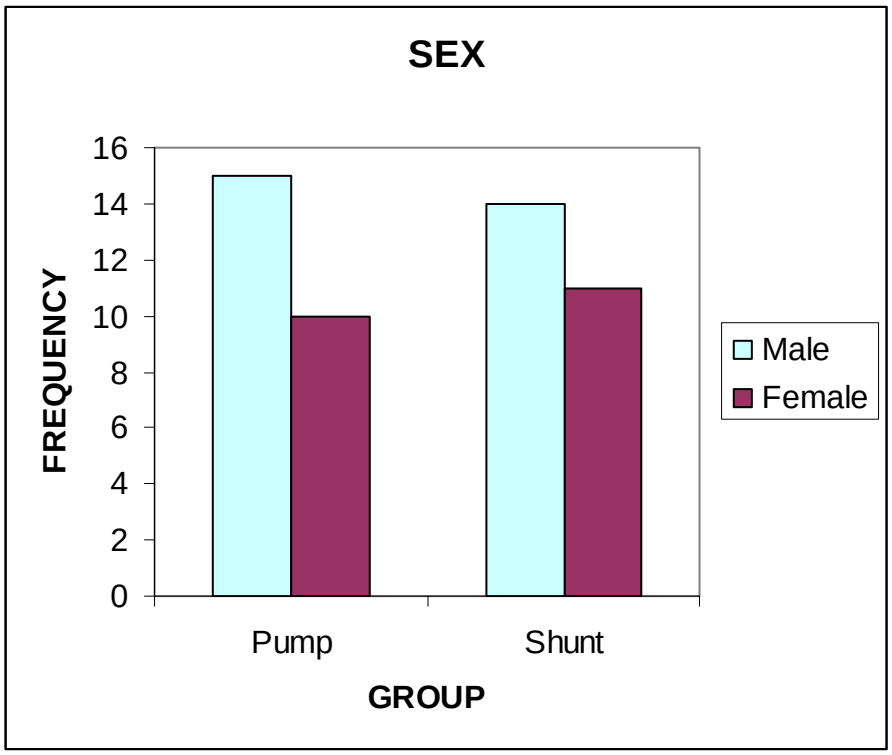
Age (years)	Number of Cases	
	Pump (No)	Shunt
10 - 20	1	1
21 – 30	3	6
31 - 40	11	8
41 – 50	6	7
51 – 60	3	3
61 - 70	1	0
Total	**25**	**25**



The maximum number of patients in both groups were found to be in the 31-40 age group.

ii. SEX

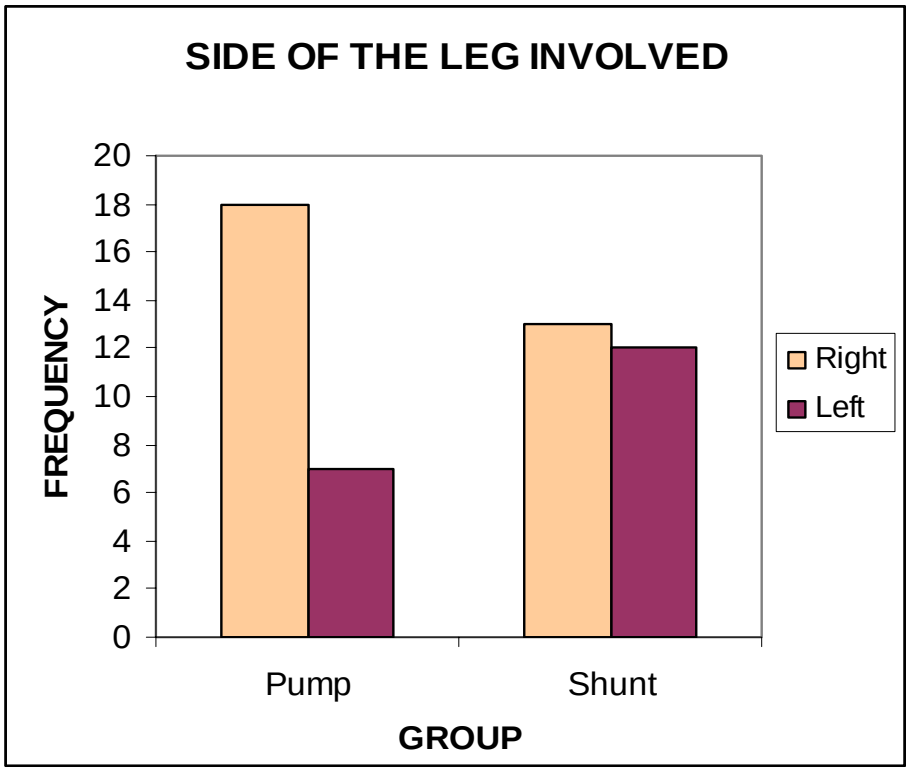
Group	Male	Female	Total
Pump	15	10	25
Shunt	14	11	25



In both the groups, males were found to be more in number when compared to females.

iii. SIDE:

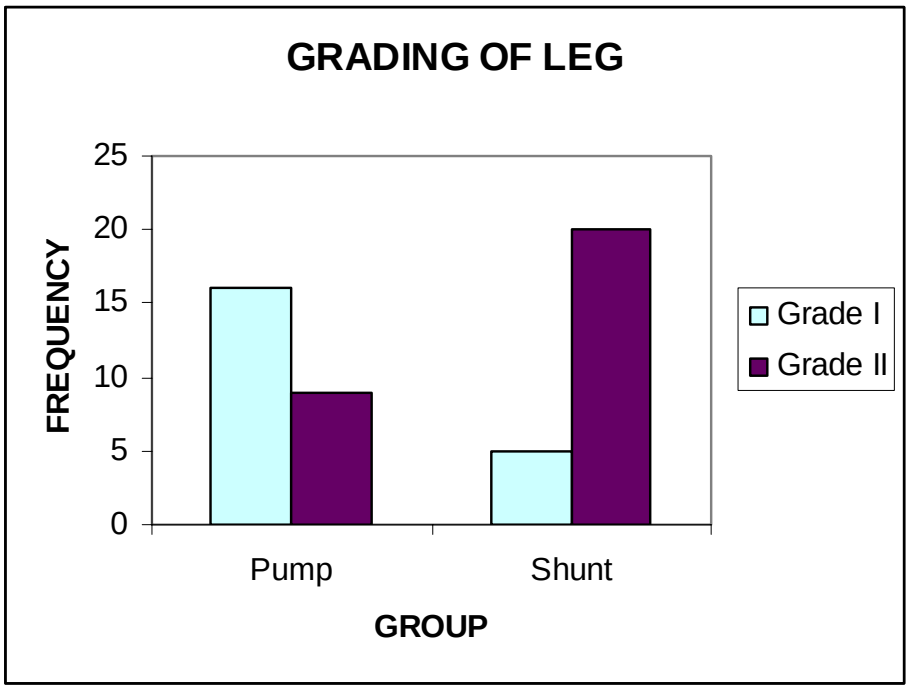
Group	Right	Left	Total
Pump	18	7	25
Shunt	13	12	25



Right side was predominant in both groups.

iv. GRADE

Group	Grade I	Grade II	Total
Pump	16	9	25
Shunt	5	20	25



Pump group had more number of Grade I patients.

Shunt group had more number of Grade II patients.

CLINICAL FEATURES:

PARAMETER	NUMBER OF CASES	
	PUMP	SHUNT
Fever	25	25
Adenitis	23	25
Pain	11	13
Fungus	0	3
Caries	1	2
Hydrocele	0	1
Family history	1	1

Fever was present in all the patients studied in both groups.

Adenitis was also present in 23 of 25 patients in the Pump group and all the patients included in the Shunt group had Adenitis.

Pain was present in only among 11 patients in the Pump group and among 13 patients in the Shunt group.

In the associated illnesses studied-(viz. Fungal infection, Caries and Hydrocele) Fungal infection was present only in 3 patients of the Shunt group.

Caries tooth was found in 1 patient of the Pump group and 2 of the Shunt group.

Hydrocele was detected in 1 patient of the Shunt group.

Family history was present in 1 patient from each group.

Patients with associated illnesses were appropriately treated.

Regarding the skin texture an observation was made.

Patients undergoing Nodo-venous Shunt had a supple skin whereas those under Pump therapy had a firm texture.

MEASUREMENTS:

Mean value of Paired-samples statistics at 12cm for the Foot and 20 cm for the Leg were obtained and analysed.

The Mean value of Day1 was taken as Baseline value and compared with Days-7, 30, 180 using Paired-sample t test.

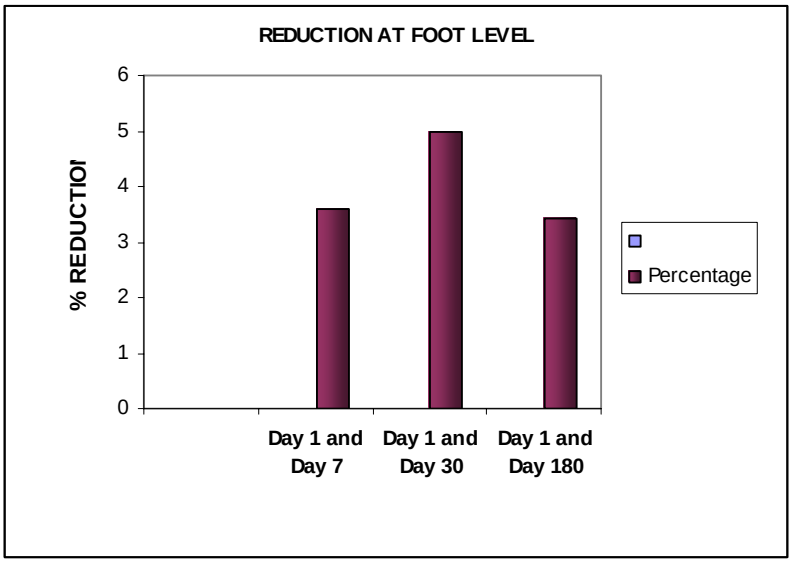
Results are tabulated as follows:-

1. PUMP THERAPY

1-1: Foot (at 12 cms)

Paired Difference	Mean Difference Cms	Percentage	p value
Day 1 and Day 7	0.92	3.59 %	0.005 *
Day 1 and Day 30	1.28	4.99 %	0.005 *
Day 1 and Day 180	0.88	3.43 %	0.005 *

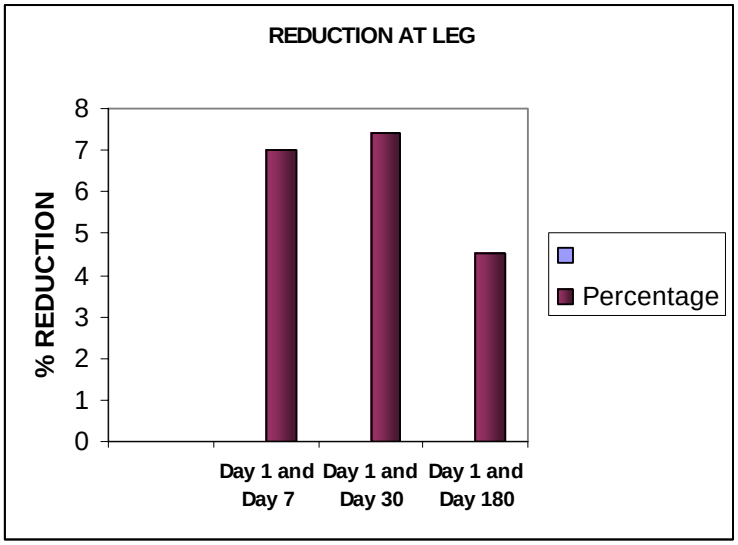
* - Significant



1-2: Leg (at 20 cms)

Paired Difference	Mean Difference Cms	Percentage	p value
Day 1 and Day 7	2.16	7 %	0.005 *
Day 1 and Day 30	2.28	7.4 %	0.005 *
Day 1 and Day 180	1.4	4.54 %	0.005 *

* - Significant



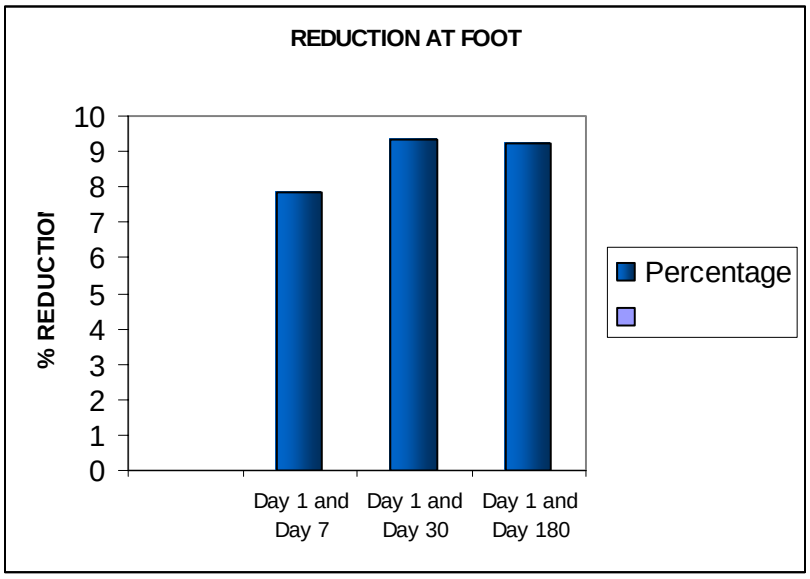
The mean difference values obtained for both Foot and Leg was found to be statistically significant as evidenced by the p value (< .005).

2. SHUNT THERAPY

2-1: Foot (at 12 cms)

Paired Difference	Mean Difference Cms	Percentage	p value
Day 1 and Day 7	2.08	7.84	0.005 *
Day 1 and Day 30	2.48	9.35	0.005 *
Day 1 and Day 180	2.44	9.2	0.005 *

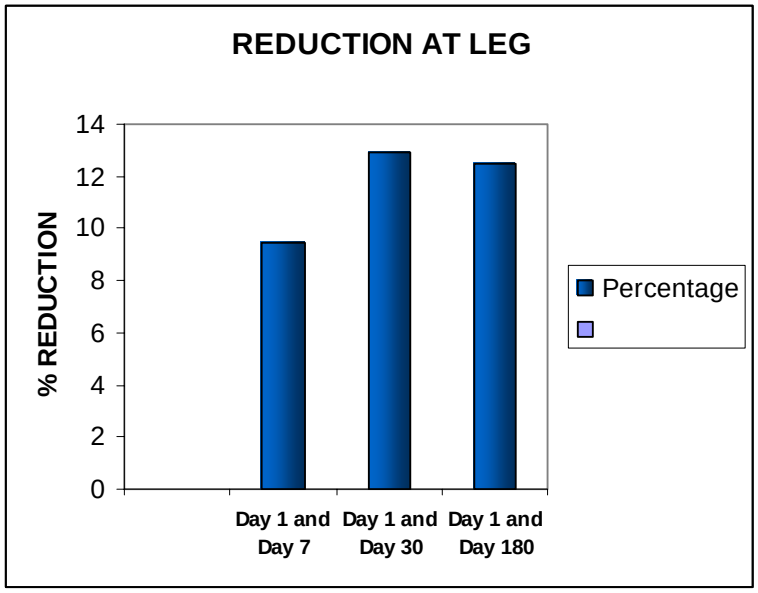
* - Significant



2-2: Leg (at 20 cms)

Paired Difference	Mean Difference Cms	Percentage	p value
Day 1 and Day 7	3.12	9.44	0.005 *
Day 1 and Day 30	4.28	12.95	0.005 *
Day 1 and Day 180	4.12	12.46	0.005 *

* - Significant



The mean difference values obtained for both Foot and Leg was found to be statistically significant as evidenced by the p value (< .005)

COMPARISON BETWEEN THE PUMP THERAPY AND SHUNT THERAPY

Difference in reduction at Foot:

Table 1

Paired Difference	PUMP		SHUNT	
	Mean Difference Cms	Percentage	Mean Difference Cms	Percentage
Day 1 and Day 7	0.92	3.59	2.08	7.84
Day 1 and Day 30	1.28	4.99	2.48	9.35
Day 1 and Day 180	0.88	3.43	2.44	9.2

Difference in Reduction at Leg:

Table 2

Paired Difference	PUMP		SHUNT	
	Mean Difference Cms	Percentage	Mean Difference Cms	Percentage
Day 1 and Day 7	2.16	7	3.12	9.44
Day 1 and Day 30	2.28	7.4	4.28	12.95
Day 1 and Day 180	1.4	4.54	4.12	12.46

- Both groups exhibit a statistically significant reduction.

- Day 30 shows the best reduction in both groups and in both modalities of treatment.

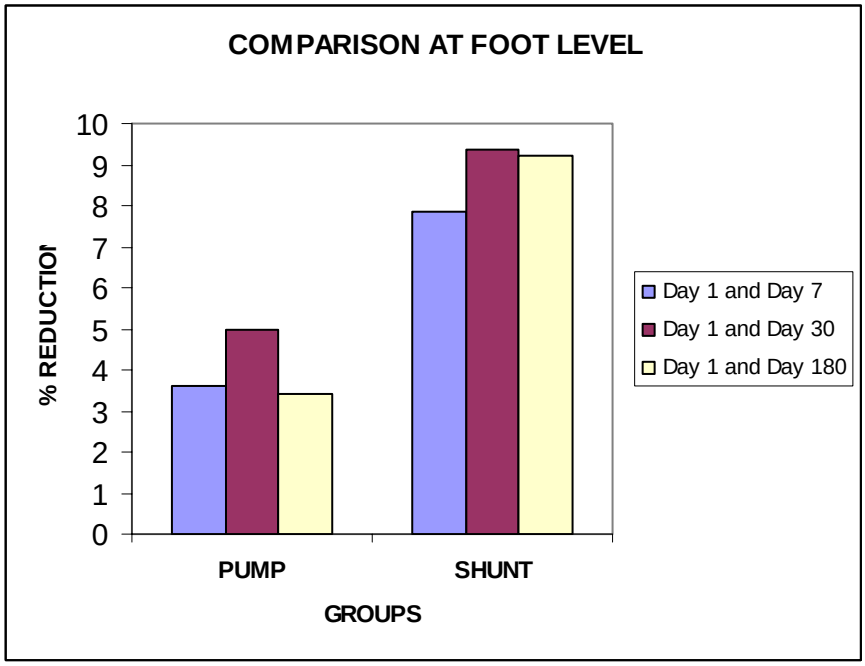
- As it approaches Day 180 some amount of reduction is lost but still the reduction is maintained in both groups.

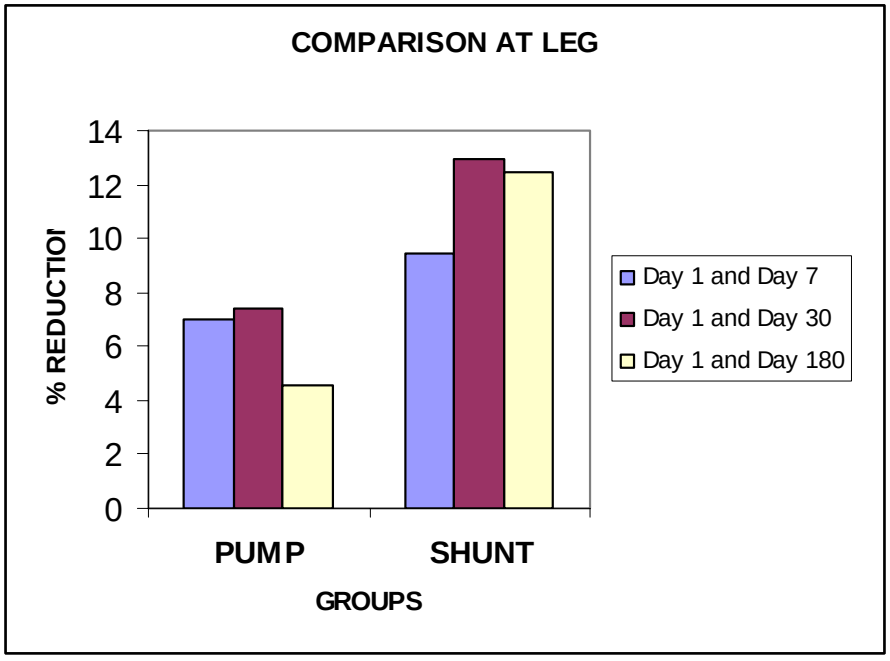
- On comparison, the Shunt group of patients exhibit more reduction than of the Pump group of patients.

COMPLIANCE:

SCORES	FREQUENCY	
	PUMP	SHUNT
1 – 4	18	18
4 – 6	7	7

Only 7 patients out of 25 in each group could score 4 and above which suggests that these were the patients who followed the advise of Limb elevation, wearing of Compression stockings and making regular periodical visits for Penidure prophylaxis.


COMPARISON AT FOOT LEVEL
% REDUCTIO
10
9
8
7
6
5
4
3
2
1
0
PUMP
SHUNT
GROUPS
Day 1 and Day 7
Day 1 and Day 30
Day 1 and Day 180


COMPARISON AT LEG
% REDUCTIO
14
12
10
8
6
4
2
0
PUMP
SHUNT
GROUPS
Day 1 and Day 7
Day 1 and Day 30
Day 1 and Day 180

DISCUSSION

On analysing the data in my study- Comparison of Pump therapy and Nodo-venous Shunt therapy on early Filarial Lymphedema (i.e. Grade I and II legs, the results of the study has shown,

That Pump therapy produces statistically significant reduction at both Feet and Legs.

The analysis of the Shunt group also show a statistically significant reduction in both feet and legs which was higher than that of the Pump group.

On studying the trends of reduction, it was noticed that patients showed maximum reduction on Day 30 in both groups.

Day 180 evaluation revealed that both groups tend to have a marginal increase in circumference at both foot and leg levels, but still, the reduction that was present was statistically significant when compared to the circumference on Day 1.

This may be due to the changes that occur in the legs which tend to become more fibrotic as time goes on. Other factors or limitations that might contribute are, the failure on the patients' part to apply elastic compression as they were taught and failure to adhere to antibiotic prophylaxis.

Having found that, Pump therapy is also an effective tool in the management of early Filarial Lymphedema and being a non-invasive procedure, it can be used in selected patients. Also the results of Pump therapy are in line with that of Nodo-venous Shunt therapy which has been a bench mark in the management of Lymphedema in our institution, thereby increasing our options in the treatment of Filarial Lymphedema – at least in early cases (Grade I & II).

As often quoted in studies sustained compression by diligent wearing of elastic devices – garments, stockings, bandages is of importance which needs patients' education followed by patient co-operation. (39)

CONCLUSION

Pump therapy and Nodo-venous Shunt therapy are effective as separate treatment modalities in the treatment of Early Filarial Lymphedema (Grade I & II Legs).

Patients on Nodo-venous Shunt therapy show increase amount of reduction when compared with that of the Pump therapy patients.

Pump therapy being a non-invasive procedure is an useful tool in the treatment of early Filarial Lymphedema and also in patients unwilling to undergo any form of surgery.

BIBLIOGRAPHY

1. Management of Lymphedema in India – A suggested protocol for prevention and Treatment. Judith R Casley Smith P.151. Progress in Lymphology – XVII

2. Schinger A, Harisan EG; James JM: Idiopathic Lymphedema. Review of 131 cases. JAMA 1962; 182 : 124-132.

3. Szuba A, Rockson S: Lymphedema: Anatomy, Physiology and Pathogenesis. Vascular Medicine 1997; 2 : 321-326.

4. Browse NL, Stewart G: Lymphedema: Pathophysiology and Classification. Journal of Cardiovascular Surgery 1985; 26 : 91-106.

5. Crockett DJ : Lymphatic Anatomy and Lymphedema. British Journal of Plastic Surgery 1965; 18:12.

6. Stone EJ, Hugo NE: Lymphedema. Surgery Gynecology Obstetrics 1972; 135:625.

7. Witte M.H, Honto D, Witte CL: Clinical and experimental techniques to study lymphatic system. Vascular Surgery 1977; 11:20.

8. Foldi E, Foldi. M, Clodius L: The Lymphedema Chaos: Annals of Plastic Surgery 1989; 22:505.

9. Reed RK, Laurant TC, Taylor AE: Hyaluronan in prenodal Lymph from skin: Changes with Lymph flow. American Journal of Physiology 1990; 259: 1097-1100.

10. Foldi J: Physiology and pathophysiology of Lymph flow. Clodius. L, ed: Lymphedema. Stuttgart. Thieme, 1977: 1-11.

11. Piller NB: Macrophage and Tissue changes in the developmental phases of secondary lymphedema and during conservative therapy with benzopyrene. Archives of Histology Cytology 1990; 53: 209-218.

12. Ryan T, de Berher D: The interstitium connective tissue environment of the lymphatics and angiogenesis in human skin. Clinic Dermatology 1995; 13: 431-455.

13. Wolfe JHN, Kinmonth JB: The prognosis of primary lymphedema of lower limbs. Archives of Surgery 1981; 116: 1157-1160.

14. Lymphatic Filariasis – Tropical medicines' origin will not go away (editorial) Lancet 1987; 1:1409.

15. Stemmer R: A Clinical symptom for the early and differential diagnosis of lymphedema. Vascular Surgery 1976; 5:261-262.

16. Rockson SG, Miller LT, Senie R, et al: American Cancer Society Lymphedema Workshop. Workgroup III. Diagnosis and

Management of Lymphedema. Cancer 1998; 83 (Supplement 12): 2882-2885.

17. Parks' text book of Prevention and Social Medicine . 19th edn: K. Park. M/s Benarasides. Bhanot 220-224.

18. Mansons' tropical diseases. Chapter 82. P.E.Simons. 1487-1552. 21st edn: Saunders.

19. Kobayashi MR, Miller TA: Lymphedema Clinics in Plastic Surgery 1987; 14:303.

20. Lymphatic Filariasis. Fourth report of WHO Expert Committee on Filariasis 1984; 702: 3-112.

21. S. Jamal. Grading of Chronic Lymphedema. Further refinement proposed. Progress in Lymphology – XI. 1988: 505-508.

22. The Science and art of Lymphatic Filariasis Elimination in India: Hope for the next Millennium. A report. 177-189. Progress in Lymphology XVII.

23. Morgan RG; Carley. Smith JR, Moses MR, et al: Complex physical therapy for Lymphedematous arm: Journal of Hand Surgery. British 1992; 17:437-441.

24. Foldi M: Treatment of Lymphedema (editorial) Lymphology 1994; 27: 1-5.

25. Foldi E., Foldi M, Weisslader H: Comparative Treatment of Lymphedema of the limbs. Angiology 1989; 36: 171-180.

26. Richmond DM, O' Donell TF, Zallikowski A: Sequential pneumatic compression for Lymphedema. Archives of Surgery 1985; 120; 1116-1119.

27. Casley Smith JR, Jamal S, Casley. Smith J: Treatment of Filarial Lymphedema and elephantiasis with 5,6-benzo-alpha-pyrone (Coumarin) and the effects of diethyl carbamazine DEC. Annals of Tropical Medicine Parasitology 1993; 87: 247-258.

28. S.B.Gogia: Comparative analysis of Pumps for Lymphedema. Lymphology Society of India, 6th National Conference Report, 2001; 5-8.

29. Sathyanarayan Mishra: An economy model of pneumatic compression device for treatment of peripheral lymphedema. Indian Journal of Plastic Surgery 2002; 35: 38.

30. Savage R.C: The Surgical Management of Lymphedema Surgery Gynecology, Obstetrics 1985; 160: 283-289.

31. Nielubowicz J, olszweski W, Sokolowski. J: Surgical Lymphovenous Shunts: Journal of Cardiovascular Surgery 1968; 9: 262-267.

32. O Brien BM, Sykes P, Thelfallgium Browning FS: Micro lymphatic Venous Anastamoses obstructive Lymphedema.

33. Baumeister RG, Siuda S: Treatment of Lymphedema by Microsurgical Lymphatic Grafting: What is proved? Plastic Reconstructive Surgery 1990: 85: 64.

34. Kondoleon E: Ultimate results of Kandolean operation for elephantiasis edema. 1929; 29: 104.

35. Sistrunk WE: Experiences with the Kondoleon operation for elephantiasis. JAMA 1918; 71: 800.

36. Miller TA: A surgical approach to Lymphedema. American Journal of Surgery 1977; 134:191.

37. Homans J: Treatment of elephantiasis of legs. A preliminary report. New England Journal of Medicine 1936; 215: 1099.

38. Bronsan H. Svenson H: Liposuction combined with controlled compression therapy reduces Lymphedema more effectively than Controlled Compression therapy alone. Plastic Reconstructive Surgery 1998; 102: 1058-1068.

39. Richter Elisabeth, Caldevilla Hecter, Richter Joga: The patient with Lymphedema – our best Collaborator? Progress in Lymphology XVIII. P229-232.

APPENDIX

PROFORMA

NAME :

AGE :

SEX :

IP/OP NUMBER :

OCCUPATION : ADDRESS:

LEG INVOLVED : R L BIL

HISTORY:-

Duration:

Fever Rigors:

Adenitis :

Pain :

Associated illness:

Fungus :

Caries tooth :

Hydrocele :

FAMILY HISTORY :

TREATMENT HISTORY:

Penidure prophylaxis

Yes No

Duration:

EVALUATION :

GRADING OF LEG : I / II

ALLOTMENT: Pump Therapy / NV Shunt

MEASUREMENTS:

Level	Primary	Post-Op / Post-Pump		
		1 Week	1 month	6 months
Foot – 12 Cms				
Leg - 10 Cms				
20 Cms				
30 Cms				
Difference + / -				

COMPLICATIONS:

Wound infection:

Lymphorrhea:

Systemic illness:

COMPLIANCE:

Limb elevation

Compression

Follow-up

PUMP THERAPY – MASTER CHART

S.No	Age	Sex	Side	History				Associated illness			Family History	Dur of Prophylaxis(mths)	Grade	MEASUREMENTS																Complication	Compliance
														Foot (12 CMs)				leg														
																		10 CMs				20 CMs				30 CMs					
				Duration (mths)	Fever/rigors	Adenitis	Pain	Fungus	Caries	Hydrocele				Day 1	Day 7	Day 30	Day 180	Day 1	Day 7	Day 30	Day 180	Day 1	Day 7	Day 30	Day 180	Day 1	Day 7	Day 30	Day 180		
1	47	M	R	12	YES	YES	YES	NO	NO	NO	NO	4	2	26	25	25	25	28	26	26	29	31	30	30	33	34	32	32	35	NO	1
2	42	F	R	18	YES	YES	NO	NO	NO	NO	NO	12	2	26	24	24	24	28	26	25	26	31	29	29	29	33	30	29	30	NO	6
3	38	F	R	7	YES	YES	NO	NO	NO	NO	NO	2	1	27	25	25	25	29	28	29	30	33	32	33	35	35	33	34	37	NO	1
4	18	F	R	9	YES	YES	NO	NO	NO	NO	NO	3	1	21	20	20	20	25	23	23	24	27	23	22	23	29	26	25	25	NO	6
5	43	M	L	18	YES	YES	NO	NO	NO	NO	NO	12	1	27	26	26	27	30	29	28	32	32	30	31	35	35	33	34	37	NO	1
6	34	F	L	8	YES	YES	YES	NO	NO	NO	NO	6	1	24	23	23	23	27	25	25	24	29	27	27	27	30	28	29	29	NO	6
7	41	F	R	18	YES	YES	NO	NO	NO	NO	NO	12	1	25	24	24	24	28	26	26	27	31	28	27	27	33	30	29	28	NO	3
8	48	M	R	24	YES	YES	YES	NO	NO	NO	NO	6	2	29	28	28	30	29	27	26	27	32	29	29	30	38	37	38	40	NO	3
9	34	M	R	36	YES	YES	NO	NO	NO	NO	NO	5	2	30	28	28	29	31	30	30	32	34	32	32	33	38	36	37	38	NO	1
10	38	F	R	9	YES	YES	YES	NO	NO	NO	NO	2	1	23	23	23	23	26	25	25	24	29	27	26	27	31	30	29	29	NO	3
11	37	F	L	12	YES	YES	NO	NO	NO	NO	NO	3	1	26	27	26	26	29	27	27	28	30	28	28	28	32	31	30	30	NO	6
12	40	M	L	8	YES	YES	YES	NO	NO	NO	NO	4	1	28	27	27	28	30	28	29	29	33	31	32	31	36	34	34	33	NO	3
13	38	M	R	24	YES	YES	NO	NO	NO	NO	NO	12	2	26	25	24	23	28	26	25	25	30	27	26	27	32	29	29	30	NO	6
14	34	F	R	24	YES	YES	YES	NO	NO	NO	NO	7	2	25	24	23	25	29	28	28	30	32	31	31	33	34	33	33	34	NO	3
15	34	M	R	9	YES	YES	NO	NO	NO	NO	NO	2	2	26	25	24	24	29	28	27	27	34	32	31	30	36	35	34	34	NO	6
16	32	F	R	24	YES	YES	NO	NO	NO	NO	NO	6	2	23	23	23	24	29	26	27	28	31	28	29	32	34	32	33	36	NO	1
17	52	M	L	60	YES	YES	NO	NO	NO	NO	NO	36	2	26	25	24	24	28	26	24	26	30	27	28	29	33	30	30	32	NO	3
18	53	F	R	5	YES	YES	YES	NO	NO	NO	NO	1	1	24	23	23	24	25	23	22	23	28	28	28	28	32	32	30	30	NO	1
19	28	M	R	24	YES	YES	YES	NO	YES	NO	YES	0	1	24	23	22	23	24	22	21	21	29	26	25	25	34	31	31	32	NO	3
20	25	M	R	9	YES	NO	NO	NO	NO	NO	NO	2	1	28	26	26	25	30	29	30	30	34	32	32	33	37	35	35	36	NO	1
21	47	M	L	24	YES	YES	YES	NO	NO	NO	NO	4	1	25	24	23	23	26	24	23	24	29	27	26	26	33	32	31	31	NO	1
22	61	F	R	6	YES	YES	NO	NO	NO	NO	NO	2	1	24	24	24	25	29	27	27	27	30	27	28	28	32	31	31	31	NO	3
23	53	M	R	8	YES	NO	NO	NO		NO	NO	3	1	25	24	24	24	28	27	27	28	30	28	27	29	32	30	30	31	NO	1
24	26	M	R	9	YES	YES	YES	NO	NO	NO	NO	2	1	27	26	25	25	27	25	25	24	30	28	27	27	32	31	30	30	NO	6

SHUNT THERAPY – MASTER CHART

NO | 1

S.NO	Age	Sex	Side	History				illness			Family History	Dur of Prophylaxis(mths	Grade	MEASUREMENTS														Compli cation	Compliance
														Foot (12 CMs)				leg													
																		10 cms				20 CMs				30 CMs					
				Durationmths	Fever/rigors	Adenitis	Pain	Fungus	Caries	Hydrocele				Day 1	Day 7	Day 30	Day 180	D 1	D 7	D30	D180	D1	D7	D30	D180	D1	D7	D30	D180		
1	51	f	lt	12	yes	yes	no	no	no	no	nil	12	1	25	23	21	21	29	26	23	23	34	31	29	30	36	33	31	31	no	5
2	29	f	lt	12	yes	yes	no	no	no	no	nil	0	1	25	26	25	25	28	25	24	24	32	30	29	29	37	34	34	34	no	3
3	39	m	lt	36	yes	yes	yes	no	no	no	nil	18	2	29	26	25	25	33	30	29	30	36	32	31	31	39	35	34	34	no	6
4	39	f	rt	24	yes	yes	no	no	no	no	nil	7	2	28	26	26	28	30	28	28	29	31	29	28	30	34	33	33	35	no	1
5	32	f	lt	18	yes	yes	yes	yes	no	no	yes	6	2	26	24	24	24	31	30	30	30	34	32	31	32	36	35	34	33	no	6
6	28	m	rt	30	yes	yes	no	no	no	no	nil	1	2	29	26	26	26	32	29	28	28	34	31	29	29	36	32	31	31	no	3
7	42	m	rt	8	yes	yes	no	no	no	no	nil	2	2	29	27	27	26	31	28	28	26	33	30	30	29	34	31	31	30	no	1
8	21	f	rt	9	yes	yes	no	no	no	no	nil	3	2	28	25	24	24	30	27	26	25	32	29	28	27	33	29	29	29	no	6
9	48	m	lt	24	yes	yes	yes	no	no	no	nil	12	2	26	25	24	24	29	26	26	25	31	28	27	26	33	30	29	29	no	3
10	38	f	rt	36	yes	yes	no	no	no	no	nil	24	2	28	25	24	24	34	32	30	30	37	34	33	34	39	36	35	35	no	3
11	22	f	lt	36	yes	yes	no	no	yes	no	nil	24	2	26	23	23	23	23	29	26	25	31	29	27	26	32	30	29	29	no	3
12	52	m	rt	48	yes	yes	no	no	no	yes	nil	12	2	27	25	25	25	32	29	29	28	35	32	30	30	36	33	32	31	no	6
13	41	m	rt	48	yes	yes	yes	no	no	no	nil	30	2	24	22	22	22	28	26	24	24	30	26	25	25	32	28	28	28	no	3
14	40	f	lt	36	yes	yes	yes	no	no	no	nil	18	2	27	25	25	24	28	25	24	24	31	29	28	29	32	29	28	30	no	3
15	38	m	rt	36	yes	yes	no	no	no	no	nil	24	2	27	25	24	24	25	33	32	31	38	35	33	35	40	36	34	35	no	1
16	41	m	lt	30	yes	yes	yes	no	no	no	nil	24	2	27	24	23	24	31	28	27	27	34	30	29	29	37	32	32	33	no	1
17	48	m	rt	36	yes	yes	yes	no	no	no	nil	12	2	28	25	25	24	30	27	26	25	34	30	29	29	37	35	34	34	no	6
18	43	f	rt	18	yes	yes	yes	yes	no	no	nil	6	2	23	22	22	22	29	26	25	25	33	29	28	27	36	32	32	32	no	3
19	45	f	lt	36	yes	yes	yes	no	no	no	nil	24	2	25	23	22	22	30	27	25	26	31	27	26	26	35	30	30	30	no	6
20	24	m	rt	12	yes	yes	yes	no	no	no	nil	1	1	26	25	25	25	31	28	28	27	34	30	30	29	36	32	31	30	no	1
21	34	f	lt	24	yes	yes	no	no	yes	no	nil	8	1	24	22	22	22	27	24	23	24	29	26	25	25	31	29	28	28	no	3
22	56	f	rt	36	yes	yes	yes	yes	no	no	nil	12	2	30	27	27	28	34	31	30	31	38	34	32	33	41	38	37	37	no	1

23	17	f	lt	18	yes	yes	yes	no	no	no	nil	3	2	28	25	25	26	30	27	26	28	33	30	29	30	39	36	35	37	no	1
24	40	m	lt	42	yes	yes	yes	no	no	no	nil	8	2	22	21	21	21	24	22	21	21	29	26	25	25	31	29	27	27	no	3
25	23	m	rt	9	yes	yes	no	no	no	no	nil	2	1	26	24	24	23	27	24	23	24	32	29	28	28	33	31	32	32	no	1